

Docket No. 049617-P020US-09606318

2

PATENT

1. A system for accepting a set of  $n$  input signals for presentation to  $x$  speakers, where  $x$  is any number, and wherein one of said  $n$  input signals is a center speaker sound signal, said system comprising:

means for expanding in pairs certain of the signals for presentation to the  $x$  speakers;

means for expanding in pairs others of the input signals for presentation to the  $x$  speakers;

means when  $x$  is less than  $n$  for summing the expanded signal pairs for presentation to said  $x$  speakers; and

means when  $x$  is less than  $n$  for summing said center speaker sound signal with one of said expanded pairs of input signals prior to said presentation to said  $x$  speakers.

3. The invention set forth in claim 1, further comprising means for attenuating said center sound signal prior to said summing of said center speaker signal.

4. The invention set forth in claim 3, wherein said attenuating is in the range of 0dB to 6dB.

5. The invention set forth in claim 1, wherein at least one of said expanding means includes a QX filter, wherein said QX filter provides an expanded stereo sound image.

6. The invention set forth in claim 1, wherein at least one of said expanding means includes an OMNI<sub>2</sub>3D filter, wherein said OMNI<sub>2</sub>3D filter provides an expanded surround sound image.

7. The invention set forth in claim 1, wherein at least one of said expanding means includes a pair of Q1 filters.

8. The invention set forth in claim 1, wherein  $n$  is 5 and  $x$  is 3.

Docket No. 049617-P020US-09606318

3

PATENT

9. The invention set forth in claim 1, wherein the first pair of input signals are for presentation to the front left and right speakers and wherein the other of said input pairs are for presentation to left and right rear speakers which are not physically present.

10. The invention set forth in claim 9, wherein the rear pair of input signals are either monaural or stereo.

11. The invention set forth in claim 10, wherein said other signal expansion means includes a pair of Q1 filters.

12. The invention set forth in claim 10, wherein said other signal expansion means includes an OMNI<sub>2</sub>3D filter.

13. The invention set forth in claim 9, wherein the rear pair of input signals are monaural.

14. The invention set forth in claim 13, wherein said other signal expansion means includes an OMNI<sub>2</sub>3D circuit.

16. The invention as set forth in claim 1, wherein at least one of said expanding means includes a QX dual filter.

17. The invention as set forth in claim 16, wherein said QX dual filter includes means for attenuating the signals input to said QX dual filter in the range of -20dB to -80dB.

Docket No. 049617-P020US-09606318

4

PATENT

18. A method for accepting a set of  $n$  input signals for presentation to  $x$  speakers, where  $x$  is any number, and wherein one of said  $n$  input signals is a center speaker sound signal, said method comprising the steps of:

- expanding in pairs certain of the signals for presentation to the  $x$  speakers;
- expanding in pairs others of the input signals for presentation to the  $x$  speakers;
- summing the expanded signal pairs when  $x$  is less than  $n$  for presentation to said  $x$  speakers; and
- summing said center speaker sound signal with at least one of said expanded pairs of input signals when  $x$  is less than  $n$  prior to said presentation to said  $x$  speakers.

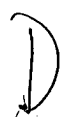
20. The method set forth in claim 18, further comprising the step of:  
attenuating said center sound signal prior to said summing of said center speaker signal.

21. The method set forth in claim 20, wherein said attenuation is in the range of 0dB to 6dB.

23. The method set forth in claim 18, wherein at least one of said expanding steps includes passing the sound signal through at least one QX filter, wherein said at least one QX filter provides an expanded stereo sound image.

24. The method set forth in claim 18, wherein at least one of said expanding steps includes the step of passing said sound signal through at least one OMNI<sub>2</sub>3D filter, wherein said at least one OMNI<sub>2</sub>3D filter provides an expanded surround sound image.

25. The method set forth in claim 18, wherein at least one of said expanding steps includes the step of passing said sound signal through a pair of Q1 filters.



Docket No. 049617-P020US-09606318

5

PATENT

27. The method set forth in claim 18, wherein the first pair of input signals are for presentation to front left and right speakers and wherein the other of said input pairs are for presentation to rear left and right speakers which are not physically available.

28. The method set forth in claim 27, wherein the rear pair of input signals can be either monaural or stereo.



Docket No. 049617-P020US-09606318

6

PATENT

29. A circuit for converting four input sound signals which are for presentation to four speakers, to two sound signals which are for presentation to two of the four speakers, wherein the four speakers are left front, right front, left rear and right rear, and wherein the two speakers are the left front and the right front speakers, the circuit comprising:

means for passing the front left and right input signals through a QX filter to form a front output pair of signals having a left and right component to provide an expanded stereo sound image;

means for passing the rear input signals through a mono to stereo filter to form a rear output pair of signals having a left and right component to provide an expanded surround sound image, wherein said rear input sound signals for presentation to the rear left and rear right speakers can be monaural or stereo signals; and

means for individually summing the left and right components of said front output pair of signals with the left and right components of said rear output pair of signals to form a single pair of left and right signals for presentation to said left front and right front speakers.

30. The circuit set forth in claim 29, wherein said input sound signals further include a center sound signal for presentation to a center front speaker and wherein said circuit further includes:

means operable when said center front speaker is not present for attenuating said center input sound signal; and

means for presenting said attenuated signal to said individually summed front output pair of signals.

33. The circuit set forth in claim 30, wherein said attenuating means operates within the range of 0dB to 6dB.

34. A method for converting four input sound signals which are for presentation to four speakers, to two sound signals which are for presentation to two of the four speakers, wherein the four speakers are left front, right front, left rear and right rear, and wherein the two speakers are the left front and the right front speakers, comprising the steps of:

Docket No. 049617-P020US-09606318

7

PATENT

passing the front left and right input signals through a QX filter to form a front output pair of signals having a left and right component to provide an expanded stereo sound image;

passing the rear input signals through a mono to stereo filter to form a rear output pair of signals having a left and right component to provide an expanded surround sound image, wherein said rear input sound signals for presentation to the rear left and rear right speakers can be monaural or stereo signals; and

individually summing the left and right components of said front output pair of signals with the left and right components of said rear output pair of signals to form a single pair of left and right signals for presentation to said left front and right front speakers.

35. The method set forth in claim 34, wherein said input sound signals further include a center sound signal for presentation to a center front speaker and wherein said method further includes the steps of:

attenuating said center input sound signal when said center front speaker is not present; and

presenting said attenuated signal to said individually summed front output pair of signals.

37. The method set forth in claim 35, wherein when said rear input sound signals are monaural said method further includes the steps of:

converting said sound signals from monaural to stereo sound signals.

38. The method as set forth in claim 37, wherein said converting step includes the step of:

separating said monaural signal into two equal information content input signals having a phase relationship of approximately  $60^\circ$  with one of the input signals attenuated from the other; and

applying each of these signals to respective inputs of a sound expansion sound circuit.

Docket No. 049617-P020US-09606318

8

PATENT

39. The method as set forth in claim 38, wherein the phase relationship is a phase delay and wherein the signal with the leading phase is the input signal that is attenuated.

40. The method as set forth in claim 38, wherein said attenuation is sufficient to provide an equal average loudness to a listener of sound from said transducers.

41. The method as set forth in claim 40, wherein said attenuation is sufficient to provide a sound image that is centered for a listener of sound.

42. The method as set forth in claim 40, wherein said attenuation is in the range of 0dB to 6dB.

43. The method as set forth in claim 38, wherein said phase relationship is applied over at least the range  $100 \text{ Hz} \leq f \leq 10 \text{ KHz}$ , where  $f$  is frequency.

Docket No. 049617-P020US-09606318

9

PATENT

55. A circuit for converting first input signals which contain sound signals for driving at least four sound producing transducers to second sound signals which drive three or less sound producing transducers, the circuit comprising:

- means for sound expanding a first left and right pair of said first sound signals;
- means for passing a second left and right pair of said first sound signals through a stereo producing circuit;
- means for summing the output of said stereo producing circuit with the output of said sound expanding means for presentation to said three or less sound producing transducers;
- means for accepting a sound input for driving a center speaker; and
- means, including attenuation means, for summing said accepted center sound signal with said summed other sound signals prior to presentation to said three or less sound producing transducers.

56. The circuit set forth in claim 55, wherein said stereo producing circuit includes:

- means for accepting two input signals;
- means for delaying a first one of said input signals with respect to the second one of said input signals;
- means for attenuating said second input signal with respect to said first input signal;
- means for creating from the delayed first input signal and from the attenuated second input signal two independent crossover signals having frequencies only above approximately 110 Hz;
- means for passing each of said crossover signals through respective Q1 filters to create an output signal;
- means for summing the output of the Q1 filter which is associated with the attenuated second input signal with the delayed first input signal to create a first output signal; and
- means for summing the output of the Q1 filter which is associated with the delayed first input signal with the attenuated second input to create a second output signal, said first and second outputs operable for driving spaced apart transducers to create an expanded stereo sound image signal of the input sound signal.



Docket No. 049617-P020US-09606318 10

PATENT

57. The circuit set forth in claim 56, further including:

means for splitting a monaural input signal to two equal input signals for presenting to said means for accepting two input signals.

58. The circuit set forth in claim 56, wherein said Q1 filter passing means

includes:

means for inverting the input signal; and

means for phase and amplitude adjusting the inverted signal.

59. The circuit set forth in claim 58, wherein said phase and amplitude adjusting

means includes:

means for adjusting the phase and amplitude on a frequency dependent basis.

61. The circuit set forth in claim 55, wherein said attenuation is in the range of

0dB to 6dB.

D

Docket No. 049617-P020US-09606318

11

PATENT

62. A method for converting first sound signals which contain sound signals for driving at least four sound producing transducers to second sound signals which drive three or less sound producing transducers, the method comprising:

- sound expanding a first left and right pair of said first sound signals;
- passing a second left and right pair of said first sound signals through the steps of a stereo producing method;
- summing the output of said stereo producing method with the expanded output of said sound expanding step for presentation to said three or less sound producing transducers;
- accepting a sound input for driving a center speaker;
- attenuating said accepted center sound signal; and
- summing said accepted center sound signal with said summed other sound signals prior to presentation to said three or less sound producing transducers.

63. The method set forth in claim 62, wherein said stereo producing method comprises the steps of:

- accepting two input signals;
- delaying a first one of said input signals with respect to the second one of said input signals;
- attenuating said second input signal with respect to said first input signal;
- creating from the delayed first input signal and from the attenuated second input signal two independent crossover signals having frequencies only above approximately 110Hz;
- passing each of said crossover signals through respective Q1 filters to create an output signal;
- summing the output of the Q1 filter which is associated with the attenuated second input signal with the delayed first input signal to create a first output signal; and
- summing the output of the Q1 filter which is associated with the delayed first input signal with the attenuated second input to create a second output signal, said first and second outputs operable for driving spaced apart transducers to create a stereo sound image signal of the input sound signal.

Docket No. 049617-P020US-09606318

12

PATENT

64. The method set forth in claim 63, further comprising the step of:  
splitting a monaural input signal to two equal input signals for presenting to said input  
signal accepting step.

65. The method set forth in claim 63, wherein said Q1 filter passing step includes  
the step of:

inverting the input signal;  
phase adjusting the inverted signal; and  
amplitude adjusting the phase adjusted signal.

66. The method set forth in claim 65, wherein said phase adjusting step includes  
the step of adjusting the phase on a frequency dependent basis; and wherein said amplitude  
adjusting step includes the step of adjusting the amplitude on a frequency dependent basis.

68. The method set forth in claim 62, wherein the attenuation in said attenuating  
step is in the range of 0dB to 6dB.



Docket No. 049617-P020US-09606318

13

PATENT

69. A method for creating a stereo surround sound image for a listener positioned with respect to first and second sound transducers from a plurality of sound inputs which are directed to at least four transducers, where the sound inputs for the two speakers which have been eliminated are monaural, said method comprising the steps of:

- accepting said sound inputs on two inputs;
- attenuating one of said monaural inputs;
- delaying the other one of said monaural inputs;
- modifying each of said attenuated and delayed input signals by removing therefrom all frequencies below a cutoff frequency;
- providing said modified signals to the respective inputs of Q1 filters;
- summing the output of the attenuated signal Q1 filter with the delayed first input signal to provide a first output signal for presentation to the sound transducer; and
- summing the output of the delayed signal Q1 filter with the attenuated input signal to provide a second output signal for presentation to the second sound transducer.


70. The method set forth in claim 69, wherein said cutoff frequency is 110Hz.

71. The method set forth in claim 70, wherein said Q1 filters invert, phase adjust and amplitude adjust the presented signals.

72. The method set forth in claim 71, wherein said phase adjustment is different for different frequencies.

76. The circuit set forth in claim 55, wherein said stereo producing circuit includes an OMNI<sub>2</sub>3D filter for providing an expanded surround sound image.

77. The circuit set forth in claim 55, wherein said means for sound expanding includes a QX filter for providing an expanded stereo sound image.



Docket No. 049617-P020US-09606318

14

PATENT

78. The method set forth in claim 62, wherein said stereo producing method utilizes an OMNI<sub>2</sub>3D filter for providing an expanded surround sound image.

79. The method set forth in claim 62, wherein said sound expanding step utilizes a QX filter for providing an expanded stereo sound image.

Docket No. 049617-P020US-09606318

15

PATENT

56 80. (Once Amended) A system for accepting a plurality of input signals for presentation to a plurality of speakers, said system comprising:

means for creating virtual sound images by expanding in pairs certain of the input signals for presentation to the plurality of speakers;

means for creating virtual sound images by expanding in pairs others of the input signals for presentation to the plurality of speakers, wherein at least one of said means for creating virtual sound images includes a QX filter; and

means for summing the expanded signal pairs for presentation to said plurality of speakers when the number of the plurality of speakers is less than the number of the plurality of input signals.

Please cancel claim the following claims:

Cancel claim 81

Docket No. 049617-P020US-09606318

16

PATENT

82. A circuit for converting first input signals which contain sound signals for driving at least four sound producing transducers to second sound signals which drive three or less sound producing transducers, the circuit comprising:

means for sound expanding a first left and right pair of said first sound signals;

means for passing a second left and right pair of said first sound signals through a stereo producing circuit, wherein said stereo producing circuit includes:

means for accepting two input signals;

means for delaying a first one of said input signals with respect to the second one of said input signals;

means for attenuating said second input signal with respect to said first input signal;

means for creating from the delayed first input signal and from the attenuated second input signal two independent crossover signals having frequencies only above approximately 110 Hz;

means for passing each of said crossover signals through respective Q1 filters to create an output signal;

means for summing the output of the Q1 filter which is associated with the attenuated second input signal with the delayed first input signal to create a first output signal; and

means for summing the output of the Q1 filter which is associated with the delayed first input signal with the attenuated second input signal to create a second output signal, said first and second output signals operable for driving spaced apart transducers to create an expanded stereo sound image signal of the input sound signal; and

means for summing the output of said stereo producing circuit with the output of said means for sound expanding for presentation to said three or less sound producing transducers.

Docket No. 049617-P020US-09606318

17

PATENT

83. A circuit for converting first input signals which contain sound signals for driving at least four sound producing transducers to second sound signals which drive three or less sound producing transducers, the circuit comprising:

means for sound expanding a first left and right pair of said first sound signals;

means for passing a second left and right pair of said first sound signals through a stereo producing circuit;

means for summing the output of said stereo producing circuit with the output of said sound expanding circuit for presentation to said three or less sound producing transducers;

means for accepting a sound input for driving a center speaker, wherein said center speaker is a virtual speaker; and

means, including attenuation means, for summing said accepted center sound signal with said summed other signals prior to presentation to said three or less sound producing transducers.



Docket No. 049617-P020US-09606318

18

PATENT

84. A method for converting first sound signals which contain sound signals for driving at least four sound producing transducers to second sound signals which drive three or less sound producing transducers, the method comprising:

sound expanding a first left and right pair of said first sound signals;

passing a second left and right pair of said first sound signals through the steps of a stereo producing method, wherein said stereo producing method comprises the steps of:

accepting two input signals;

delaying a first one of said input signals with respect to the second one of said input signals;

attenuating said second input signal with respect to said first input signal;

creating from the delayed first input signal and from the attenuated second input signal two independent crossover signals having frequencies only above approximately 110Hz;

passing each of said crossover signals through respective Q1 filters to create an output signal;

summing the output of the Q1 filter which is associated with the attenuated second input signal with the delayed first input signal to create a first output signal; and

summing the output of the Q1 filter which is associated with the delayed first input signal with the attenuated second input signal to create a second output signal, said first and second outputs operable for driving spaced apart transducers to create a stereo sound image signal of the input sound signal; and

summing the output of said stereo producing method with the expanded output of said sound expanding step for presentation to said three or less sound producing transducers.

Docket No. 049617-P020US-09606318

19

PATENT

85. A method for converting first sound signals which contain sound signals for driving at least four sound producing transducers to second sound signals which drive three or less sound producing transducers, the method comprising:

- sound expanding a first left and right pair of said first sound signals;
- passing a second left and right pair of said first sound signals through the steps of a stereo producing method;
- summing the output of said stereo producing method with the expanded output of said sound expanding step for presentation to said three or less sound producing transducers;
- accepting a sound input for driving a center speaker, wherein said center speaker is a virtual speaker;
- attenuating said accepted center sound signal; and
- summing said accepted center sound signal with said summed other sound signals prior to presentation to said three or less sound producing transducers.

#### REMARKS

Claim 80 has been rejected by the Examiner and are pending in the application. The outstanding issues in the present Office Action are:

- ▶ Claim 80 stands rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,546,465 to Kim;
- ▶ Claim 81 stands objected to as being dependent from a rejected claim and comprising allowable subject matter.

#### Amendment

The Examiner has stated that claim 81 comprises allowable subject matter. Accordingly, Applicants have amended independent claim 80 to include the limitation previously set forth in claim 81. Applicants have canceled claim 81. Since the Examiner has